

Percutaneous Ureteral Incision With a Small-Caliber Flexible Ureteroscope

Hatsuki Hibi, MD, Yoshiaki Yamada, MD, Hitoshi Nonomura, MD, Yukio Hatano, MD, Kenji Mitsui, MD, Tomohiro Taki, MD, Nobuaki Honda, MD, Hidetoshi Fukatsu, MD

ABSTRACT

Objectives: We reviewed the results of percutaneous ureteral incisions for ureteroenteroanastomotic stricture using the holmium laser.

Methods: We performed this procedure through a 6.9-F flexible ureteroscope on 3 ureters in 3 patients. Balloon dilation was not necessary prior to insertion of the ureteroscope. The stricture was incised with the holmium laser with a 200- μ m fiber through the working channel of the ureteroscope. After completion of the incision, a 12-F double-J ureteral stent was left in situ for 6 weeks. Thereafter, patients were followed with repeated renal scans, ultrasound, or both, and excretory urography at 3- to 6-month intervals.

Results: The stricture resolved completely in all cases at an average follow-up of 25.3 months (16 to 32 months).

Conclusions: Although the number of treated patients was small, percutaneous ureteral incision for ureteroenteroanastomotic stricture using the holmium laser was associated with a good outcome. We recommend this procedure be considered initially because it is less invasive and has a favorable outcome.

Key Words: Ureteroenteroanastomotic stricture, Percutaneous ureteral incision, Holmium laser.

INTRODUCTION

Recent improvements in the design of ureteroscopes have resulted in an increase in the effective size of the working channel with no change in the outer diameter. This has increased the therapeutic potential of the ureteroscope as well as improving its use as a diagnostic tool. In addition, modern laser technology can now be used to treat urological diseases, such as urinary tract stones, tumors, and strictures. The holmium laser is a pulsed solid-state laser with a short absorption depth in tissue (0.4 mm) and is suitable for hemostatic incision, ablation, coagulation, and stone fragmentation. At high energy levels, the holmium laser is capable of incising strictures with good hemostasis and minimal thermal damage to tissue.

The occurrence of ureteral strictures following the construction of a ureteroenteroanastomosis for urinary diversion is uncommon but is a critical problem when it arises. Fibrotic adhesions resulting from previous surgery makes the surgical repair of ureteroenteroanastomotic strictures technically challenging. However, coincidental to the increasingly widespread use of the endoscopic ureteral incision technique, which is an alternative to open surgery, several reports have been published regarding the use of the holmium laser.¹⁻⁵ In this report, we describe our technique for percutaneous ureteral incision using the holmium laser through a small-caliber ureteroscope.

METHODS

Patient Characteristics

Between August 1998 and May 2000, we performed endoscopic ureteral incisions using the holmium laser through a small-caliber ureteroscope on 17 ureters in 15 patients. Three male patients (mean age 63.3 years, range 57 to 70) had ureteroenteroanastomotic strictures. The development of the stricture resulted from ureteroenteroanastomosis of an Indiana urinary pouch in 2 patients and an ileal neobladder in 1 patient. All patients underwent excretory urography, and diuretic ^{99m}Tc-MAG³ renography, which confirmed the presence of ureteral obstruction without evidence of calculi. CT scan

Department of Urology, Aichi Medical University School of Medicine, Nagakute, Japan (Drs Hibi, Yamada, Mitsui, Taki, Honda, Fukatsu).

Department of Urology, Gamagohri City Hospital, Gamagohri, Japan (Drs Nonomura, Hatano).

Address reprint requests to: Hatsuki Hibi, MD, Department of Urology, Aichi Medical University, Nagakute, Aichi, 480-1195, Japan. Telephone: 81 561 62 3311 ext. 2145, Fax: 81 561 63 8166, E-mail: hibih@quartz.ocn.ne.jp

© 2003 by JSLS, Journal of the Society of Laparoendoscopic Surgeons. Published by the Society of Laparoendoscopic Surgeons, Inc.

and urine cytology were also performed in all patients to exclude the presence of external ureteric compression secondary to extraluminal malignancy.

Surgical Technique

A nephrostomy was performed and a biopsy of the stricture was taken prior to laser ablation to exclude any underlying malignant lesion. Two guidewires were inserted into the pouch through the nephrostomy with the patient prone, and the 6.9-F flexible ureteroscope was inserted percutaneously along the guidewire.

A dual wavelength VersaPulse Select 80W (Coherent Medical Systems, California) was used. The holmium laser was inserted through the working channel of the ureteroscope. The laser was operated at a wavelength of 2100 nm with an output of 1.0 J/pulse at a rate of 10 Hz (10 watt) and delivered from the tip firing 200 µm of bare fiber. The stricture was incised until the fat tissue surrounding the ureter was visualized in a linear fashion. After completion of the incision, a 12-F double-J ureteral stent was left in situ for 6 weeks. Patients underwent a follow-up renal scan, ultrasound, or both, and excretory urography at 3- to 6-month intervals.

RESULTS

The mean operative time was 75.3 minutes (range 38 to 114), whilst the mean length of the incised ureter was 3.7 cm. All cases were successful at the median follow-up period of 25.3 months (range 16 to 32) (**Table 1**).

The strictures could be fully incised by the holmium laser ablation with an output of 1.0 J/pulse at a rate of 10 Hz. In 1 case, the guidewire was accidentally cut by the holmium laser; but the severed wire was easily removed

with grasping forceps. No significant ureteral injury, such as ureteral dissection or perforation, occurred; and blood transfusion was not required. Follow-up renal imaging demonstrated obvious improvement in renal function and hydronephrosis, whilst pouchography revealed no ureteric reflux (**Figure 1**). No postoperative ureteral strictures or other anatomic abnormalities were observed.

DISCUSSION

Modern small-caliber ureteroscopes that utilize fiberoptic technology have a larger working channel for the same outer diameter. The miniaturization of the ureteroscope reduces ureteral dilation and facilitates both observation of the ureteric mucosa unaltered by traumatic dilation as well as allowing the ureteric stricture to be reached more easily. Maximum visibility is essential during endoscopic procedures. Although the working or irrigation channel has become larger, the flow of irrigation often becomes inadequate when trying to negotiate the severely strictured ureter. This problem has been previously reported in flexible instruments.⁶ We usually maintained an adequate view with gravity irrigation with a larger tube connected to a ureteroscope and switching to manual irrigation with a 3-way stopcock. This gravity system for irrigation is simple and adjustable, whereas a pressure pump irrigation system is costly and, in our opinion, unnecessary.

The incidence of ureteroenteroanastomotic stricture has been reported to be less than 10%. At our institution, ureteral stricture developed in 7.4% (2 of 27 cases) of patients with Indiana urinary pouch and in 4.5% (1 of 22 cases) of patients with ileal neobladder. Wilson et al⁷ reported a similar incidence of 7% (9 of 130 cases) in

Table 1.
Patient Characteristics and Outcomes

Age	Sex	Side and Site	Etiology*	Length of Stricture (cm)	Length of Incision (cm)	Operation Time (min)	Postoperative Follow-up (mos)	Outcome
70	M	Right Anastomosis	IP	2	3	74	32	Successful
57	M	Left Anastomosis	IP	5	5	114	28	Successful
63	M	Left Anastomosis	IN	2	3	38	16	Successful

*IP = Indiana urinary pouch; IN = Ileal neobladder.

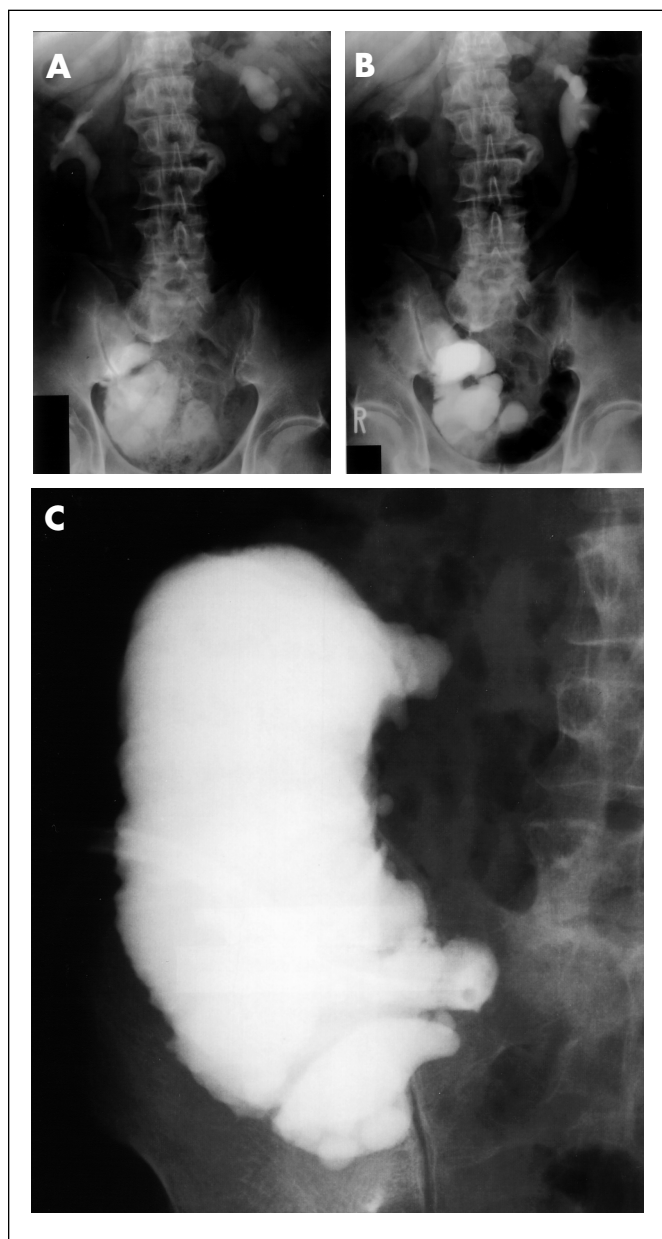


Figure 1. A 57-year-old male with an Indiana urinary pouch. Excretory urography showed left hydronephrosis (A). Hydronephrosis was completely resolved at 24 months postoperative follow-up (B). Pouchography revealed no reflux to the ureter (C).

cases of the modified Indiana urinary pouch. They recommend open ureteral reimplantation because treatment by balloon dilation resulted in a failure rate of 83%. Indeed, we believe that balloon dilation for uretero-

teroanastomotic stricture is inadequate as an alternative treatment to open surgery. An adequate incision is required after a pathological diagnosis is established from a biopsy specimen.

Endoscopic ureteral incision can be performed with a variety of devices, such as a cold knife, electrocautery, laser, or an Acucise cutting balloon, which incorporates both a monopolar electrocautery cutting wire and a low-pressure balloon. During endoscopic ureteral incision, it is important that the fibrous scar is completely cut such that periureteral fat tissue is observed because this facilitates subsequent healthy tissue growth.

Recently, Poulakis et al⁸ reported the use of the flexible cold knife for treatment of ureteroenteroanastomotic strictures, which resulted in a 74% success rate after a mean follow-up of 23 months. Cold-knife incision has the theoretical advantage of avoiding potential thermal damage to the ureter and surrounding tissue compared with that in electrocautery or laser treatment. However, data from animal models indicate that periureteral damage from an incision with electrocautery appears to be equivalent to the injury produced by the Nd:YAG laser, KTP laser, or even a cold knife. However, thermal damage was observed to be more frequent when larger (ie, 1000- μ m) probes were used.⁹

Because of its unique tissue effects and compatibility with a small-caliber flexible ureteroscope, we believe that the holmium laser is particularly useful for percutaneous ureteral incision. Acucise and the flexible cold knife are effectively "blind" procedures performed under fluoroscopic guidance. On the other hand, holmium laser ureteral incision with a small-caliber ureteroscope is performed under direct vision and is ideal for performing ureteral incision with comparative ease and precision. Although we treated only a small number of patients, all exhibited complete resolution of the stricture at an average follow-up of 25.3 months. Singal et al² also reported a favorable outcome in patients with ureteroenteroanastomotic strictures treated with a holmium laser.

At our institution, a 12-F double-J ureteral stent is left in situ for 6 weeks according to the work of Davis et al¹⁰ who demonstrated that ureteral musculature occurred after 6 weeks. The optimal ureteral stent size and duration of stenting following endoscopic ureteral incision is still controversial. It is unclear whether the stent should be used as a mold, around which the ureter reforms, or as a scaffold that only guides ureteral healing. Preminger

et al¹¹ reported, in a multicenter trial of Acucise endoureterotomy using a stent size from 7 to 10 F depending on the surgeon's preference, a stenting duration of 6 weeks. Conlin and Bagley¹² preferred using the gently tapered endopyelotomy stent (7/14 F), and they also advocated stenting for a minimum of 6 weeks. The utility of leaving stents in place for this length of time is being reviewed because some authors have now reported similar success rates with shorter stenting periods.^{13,14} Thus, both the stent size and duration of stenting are still undetermined because definitive comparisons from a prospective randomized trial are lacking.

Accidentally, the guidewire was cut by the holmium laser ablation in 1 case. Biyani and Powell¹⁵ also reported guidewire fragmentation during holmium laser endopyelotomy. Although we could remove the severed guidewire easily with grasping forceps, it is apparent that careful attention is required during the laser ablation.

Wolf et al¹⁶ reported on 30 patients with ureteroenteroanastomotic strictures who were treated with various cutting modalities. They noted that failures occurred at a constant rate for the first 3 years. Although favorable outcome was defined in our series, the possibility of development of a subsequent future stricture should not be ignored. Further study and long-term follow-up are required to make a reliable assessment of the efficacy of this procedure.

CONCLUSION

Percutaneous ureteral incision for ureteroenteroanastomotic stricture using the holmium laser was associated with a good outcome. We recommend that this procedure be considered initially because it is markedly less invasive and has a favorable outcome.

References:

1. Erhard M, Bagley DH. Urologic application of the holmium laser: preliminary experience. *J Endourol*. 1995;9:383-386.
2. Singal RK, Denstedt JD, Razvi HA, Chun SS. Holmium: YAG laser endoureterotomy for treatment of ureteral stricture. *Urology*. 1997;50:875-880.
3. Biyani CS, Cornford PA, Powell CS. Retrograde endoureteropyelotomy with the holmium: YAG laser. *Eur Urol*. 1997;32:471-474.
4. Hibi H, Mistui K, Taki T, et al. Holmium laser incision technique for ureteral stricture using a small-caliber ureteroscope. *JSLS*. 2000;4:215-220.
5. Giddens JL, Grasso M. Retrograde ureteroscopic endopyelotomy using the holmium:YAG laser. *J Urol*. 2000;164:1509-1512.
6. Bagley DH. The 6.9F semirigid ureteroscope in clinical use. *Urology*. 1993;41:45-48.
7. Wilson TG, Weinberg A, Ahlering TE. Late complications of the modified Indiana pouch. *J Urol*. 1994;151:331-334.
8. Poulakis V, Witzsch U, de Vries R, Becht E. Antegrade percutaneous endoluminal treatment of non-malignant ureteroenteroanastomotic strictures following urinary diversion. *Eur Urol*. 2001;39:308-315.
9. Delvecchio FC, Preminger GM. Endourologic management of upper urinary tract strictures. AUA Update Series. 2000;19:250-255.
10. Davis CM, Strong GH, Drake WM. Intubated ureterotomy: Experimental work and clinical results. *J Urol*. 1948;59:851-856.
11. Preminger GM, Clayman RV, Nakada SY, et al. A multicenter clinical trial investigating the use of a fluoroscopically controlled cutting balloon catheter for the management of ureteral and ureteropelvic junction obstruction. *J Urol*. 1997;157:1625-1629.
12. Conlin MJ, Bagley DH. Incisional treatment of ureteral strictures. In: Smith AD, Badlani GH, Bagley DH, Clayman RV, Jordan GH, Kavoussi LR, Lingeman JE, Preminger GM, Segura JW, eds. *Smith's Textbook of Endourology*. St Louis, MO: Berger K; 1996:497-505.
13. Meretyk S, Albala DM, Clayman RV, Denstedt JD, Kavoussi LR. Endoureterotomy for treatment of ureteral strictures. *J Urol*. 1992;147:1502-1506.
14. Kerbl K, Chandhoke PS, Figenschau RS, Stone AM, Clayman RV. Effect of stent duration on ureteral healing following endoureterotomy in an animal model. *J Urol*. 1993;150:1302-1305.
15. Biyani CS, Powell CS. Guidewire fragmentation during holmium:YAG laser endopyelotomy. *Tech Urol*. 1998;4:51-53.
16. Wolf JS Jr, Elashry OM, Clayman RV. Long-term results of endoureterotomy for benign ureteral and ureteroenteric strictures. *J Urol*. 1997;158:759-764.

This paper was presented at the 9th International Meeting of Laparoendoscopic Surgeons (SLS Annual Meeting), Orlando, Florida, December 6-9, 2000.